Monitoring of ambient systems: a challenge

[A position paper for the Somitas Workshop at Ambi-Sys 2008]

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ABSTRACT

This short position paper is about ambient systems in the sense of what is known in a research domain usually called *ambient intelligence*: communicating and mostly wireless electronic and advanced computerized components, sometimes called *ambient devices*[1]. We propose to consider the gap between today's monitoring systems for networked computing systems and what is needed for ambient systems. One of the challenges, for instance, is to create performing techniques: the monitoring system needs to periodically get information from the monitored one and the performance of the global system dramatically decreases when the frequency of the catching processus increases. Another challenge is related to time synchronization, as this problem is still not fully solved for current monitoring systems. The behavior of ambient systems is likely to be context-aware and much more dynamical than current systems: several problems occur and need new answers. From a light survey of works related to network monitoring we try to give here some material for a workshop discussion.

Categories and Subject Descriptors

C.2.3 [**Network operations**]: Network monitoring

General Terms

Monitoring, Grids, Sensors, Wireless

Keywords

Monitoring, Ambient systems, Pervasive systems

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[1]So... we are not in the domains known as *ambient monitoring* about air quality for instance. As the word *monitoring* is also widely used in medicine, and ambient medicine is becoming a reality, we have to give the precision that what is written in this article is not intending to be useful for these areas.

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1. INTRODUCTION

We understand the monitoring of ad-hoc networks as a quite recent research area [6, 24] and the monitoring of ambient systems as a currently emerging thema. We all know *\%systemroot%\System32\taskmgr.exe* and *ps (-ef..)*. Did not you recently use one of them ? Every user of a personal computer knows the basic tools for monitoring: to get the list of current processes the MicrosoftWindows *task manager* and the Unix *ps* command are probably among the most used ones. To go further you may want to be automatically *warned* or *alarmed* when some event arises like a given number of processes or a reached used memory size etc. A wide number of tools do that, cf section 2.2 hereafter. Zanikolas and Sakellariou gave in 2005 the following definition of monitoring: "the act of collecting information concerning the characteristics and status of resources of interest" [35]. They gave a taxonomy and defined in detail 4 recurrent steps of monitoring : generation of events, processing of generated events, distribution and presentation. As *events* are clearly identified as a key concept for classical monitoring this is not obviously the case for ambient systems, for which a more precise concept should be developped to take into account the context-dependance and the self-awareness of the system [30]. The networked media of the future, as drawn for instance by the European Commission synthetising several networks of excellence shows new possibilities and new challenges for monitoring such as, for instance, scalable media layering for content-based transport or dynamic admission control with UPnP[23]. We are here mostly interested in the question of monitoring ambient systems, these ones considered as a generalisation of ad-hoc networks to wifi communicating miniaturized equipments and offering possibilities of self-configuration, such as the *Conflets* system [25, 26] developped for the Safari project [29] [2]. While the communication protocols for ambient systems are still in research activities [20], especially to strenghten their reliability [13] and the market always shows needs for service provisioning [27], telecom operators may feel interested in speeding the coming up of robust monitoring systems.

2. A CHALLENGE: MONITOR AMBIENT SYSTEMS

2.1 Monitoring computing networks

At a time when computers were accessible by only one person at the same moment, monitoring and operating system

[2]Here Safari is the label of a french project which has no connexion with the well known web browser from Apple (for the Iphone for instance)

where the same, as it was the case for CMS (Cambridge, then Conversational Monitor System). Then VM was created in the US [14] and the Esope project was conducted in France [12]. Bellino et al. created the first monitoring system conceptually different from an operating system: GMS [8]. The french word was "hyperviseur" which is now used for virtual operating systems(VMware etc). In the 80's and 90's computers and telecommunications merged. Monitoring norms and standards mostly came from the telecommunication world which proposed protocols to be applied to communicating operating systems. SNMP (Simple Network Management Protocol) is probably the most reknown protocol, it was related to the most generic norm ISO FCAPS (1997) which defined a 5-layers repository for monitoring which is now widely used as a common language; the 5 levels are Fault, Configuration, Accounting, Performance, Security. The extension and application of FCAPS to active networks has been studied by Boutana and Polyrakis [10].

2.2 Some tools

In the past ten years the need for monitoring of networked computers has generalized. In their state-of-the-art[3] in 2004 Gerndt et al. gave a comparative study of 26 systems [17]. Some of them are in fact part of a complete toolkit for distributed systems, like Askalon for instance [16]. Some of them are simulation tools, mainly designed to enhance performance, like Dimemas [5]. Most of them were first designed for wired systems. In 1995 the Network Monitoring Task Force [4]in the United States (Stanford University) gave a list of 44 tools to monitor networks, including for instance the famous HPOpenView [5], but also elementary things like *telnet* or *ping*. The Stanford Linear Accelerator Center maintains a list of network monitoring tools and systems [6]. Just to give an idea, about 50 tools have been added to the list in 2007. Tools which are now widely used such as Ganglia, Nagios, newly successful tools like Monit [7] in the freeware world [19, 22], and BMC Patrol [8] [9, 33] and its successors, are not yet ready to handle ad-hoc networks. Ganglia is based on a multicast-based listen/announce protocol. BMC Patrol is based on an *intelligent* (autonomous) agent processus: an agent processus is alive on every monitored computer and sends information and alarms to a central one: the "console". The information needed for monitoring is structured with so-called "knowledge modules" which are autonomous packages structured with monitoring objects. These objects are not fully compatible with the standard "object-oriented" approach in software engineering, as they were not first designed to be encapsulated, reusable or subject to inheritance mechanisms. In the CORBA world, most recent works allow us to intercept and centralize CORBA messages: this is done by tools like Corbamon [34] for instance. Now, in a quite similar way to what happened 12 years ago at the time when Patrol was created [9] the challenge is to find ways to monitor communicating entities becoming grids, two main differences come from the fact that, of course, wireless communication is generalising, and communicating entities are becoming *smart* objects achieving a possibility of self-organisation [1, 21, 18, 31, 11]. A first step towards the monitoring of ambient systems can be the monitoring of ad-hoc networks, which is currently a dynamic domain of research activities. Akyildiz gave in 2005 a survey on wireless mesh networks [2, 3] and most recently a survey on wireless multimedia sensor networks. The challenges they propose for ad-hoc networks should be published in 2008 [4]. If not already pointed out, we propose here to add: monitoring of ambient ad-hoc networks.

2.3 Some works

- Wanmon (first from Sidney and South Wales Univ, Australia) [24] is a prototype for a Wireless Ad-hoc Networks monitoring tool which proposes several useful statistics reports. It is limited to static routing and gives no detailed information about CPU usage. Published in 2003 these work and tool were innovative.

- Madynes [9] is a project from the LORIA (University of Nancy, France), leader of the EMANICS european network of excellence for the monitoring of dynamic networks. In his quite recent thesis (dec. 2006) Badonnel [6] gave the following definition of mobile ad-hoc networks: a self-organized spontaneously constructed network from a number of communicating mobile entities, without previously existing structure. Since we may consider that ambient systems are ecosystems living in ad-hoc networks mostly based on miniaturized communicating entities, this work gives us an interesting point of view. Badonnel developped a probabilistic approach to extend ANMP (ad-hoc networks management protocol) [7].

- Time synchronization in ambient systems and ad-hoc networks is a key problem [15]. Some years ago (in 2004) Sivrikaya and Yener [32] experimented in detail protocols like *Reference Broadcast Synchronization* and *Timing-Sync Protocol for Sensor Networks* (both from Berkeley) and proposed a new technique by aggregating the synchro requests. Recently, Razafindralambo and Mitton showed how it is actually possible to synchronize self-organizing ad-hoc networks with a probabilistic approach and Markov chains to avoid the notification of simultaneaous packets [28].

3. CONCLUSION

Several questions are open for the monitoring of ambient systems because the classical managing of events is no more efficient, and time synchronization models should be updated. A small number of tools and systems are independant of the physical layer of the network and may be easily adapted to wireless systems, but considering some intelligent-like behaviors of future ambient systems, like the adaptation to the context, dynamic self-organisation and so on, the need for performing new techniques is now challenging.

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[3] APART Workshop White Paper

[4] Still on line here: http://www.slac.stanford.edu/~cottrell/tcom/survey3-results.html

[5] ©OpenView property of Hewlett-Packard Inc.

[6] http://www.slac.stanford.edu/xorg/nmtf/nmtf-tools.html

[7] This has to be checked (december 2007)

[8] ©Patrol is property of BMC Software Inc.

[9] http://madynes.loria.fr/

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